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ABSTRACT

This discussion of the principal structures and factors that modify data in the decision making process considers individual-environmental structures in terms of their influences on data, as well as such factors as personality, cultural antecedents, data complexity, data load, task demand, and the individual's congruency with both the environment and the data as decision making variables. Interdisciplinary areas that can significantly contribute to an understanding of human information processing are identified, and consideration is given to the role libraries can and should play in the decision making process, with special attention to those libraries that serve administrators. (JEG)

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Data and the Decision-Making Process

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Abstract

This paper presents the principle structures and factors that modify data in the decision-making process. Various individual-environmental structures will be considered in terms of their influences on data. Attention is also given to factors such as personality, cultural antecedents, data complexity, data load, task demand, and the individual's congruency with both the environment and the data as decision-making variables.

From this introduction, the paper identifies interdisciplinary areas that can significantly contribute to an understanding of human information processing. Finally, consideration is given to the role that libraries, i.e., banks of retrievable data, can and should play in this decision-making process. Special attention is given to those libraries that serve our administrators-administrative libraries.

Introduction

As we all know, librarianship has been concerned for the most part with the acquisition and organization of publications in ways that will make them and the facts therein available to people. Almost all research and systems design in librarianship has been directed ultimately toward

improving interaction between publications and users. Information science extended this interest to include all forms of recorded data, and it also looked beyond practical professional applications to the identification of basic principles and concepts.

It should also be noted that both the profession of librarianship and the information science discipline have focused attention on retrievable data, that is, data that is recorded or stored in such a way that it can be recalled repeatedly without alteration. More simply put--the printed word, rather than facts stored in someone's memory. The user's mind in such studies has been seen almost exclusively as a "black box" in which data input stimulates something and a reaction is observed at the output. About the only information scientist who has been willing to look inside that "black box" has been Anthony Debons and his followers at the University of Pittsburgh.

On the other hand, other disciplines, such as psychology and computer science, study the internal structures that enhance and deter data flow in individuals. Psychology is interested in describing the internal structure of the individual; and computer science (especially in the work done by Herb Simon at Carnagie-Mellon University) is interested in simulating these structures with computers.

The purpose of this presentation is to describe the contribution that psychology can make toward understanding the information processes for both librarianship and information science; and to demonstrate ways in which psychology can contribute toward a deeper and broader understanding of what we do in the administration of libraries. I will begin by setting some boundary conditions and a point of view. This will be

followed by a description of the milieu between the individual and his environment; and then by an analysis of the various factors that influence this process. I will close with a discussion of application and further research that is needed.

Some Initial Conditions

We in the information field suffer for lack of clear definitions of what we mean by the basic phenomena of interest to us. For example, Kvale recently listed 13 different definitions for the word "data." We could add to this all the variations in the meaning of information, knowledge, publications, facts, etc.[1] We will consider data as basic entities carried by sense stimuli to and from the environment or stored in an individual's memory. They exist in and of themselves and have no intrinsic value or meaning. This data becomes knowledge when the individual attaches a value or meaning function to it. Furthermore this knowledge is personal and does not exist outside the individual in the environment. Finally we define information as the process on data that changes the state of the individual through his interactions with data. I will try to be consistent in the use of these terms even though the results may seem a bit awkward at times.

Psychology and sociology have long recognized an individual as two different persons. He behaves one way as a part of a social group, and another as an independent individual. Today I will limit my attention to the individual. A corollary argument could be developed for the person as a part of a social group although the parameters and measurements would differ.

Finally, it is assumed that the individual does not simply exist in an environment and react to it. He actively interacts with this environment and continually constructs man-environment systems to suit his needs. This is also true of the researcher who is studying this man-environment phenomenon. He too constructs models of systems that will enhance or deter the flow of data or the unity between man and his environment. We will therefore be discussing data and informative constructs not a static structure, but rather as variables or parameters in the whole process.

Man-environment Paradigm

Let us begin with a general construct of the data flow between an individual and his environment. The environment is normally seen as a source of data received by the individual and as a receptacle for that individual's data output. It is sufficient for our purpose to focus on the mind and describe the individual in terms of three elements (input, process and output) with connections between each and the environment. This system is shown graphically in Figure 1.

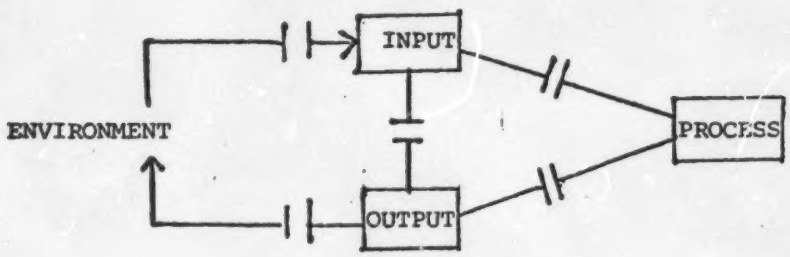

Figure 1

The input and output elements act only as transducers and switching units with all modifications of the data occuring in the processor.

Memory is assumed to reside in the interface between input and output. The interfaces are elements that can be considered as part of either unit to which they are connected depending on the inquirer's point-of-view. This interface concept has been developed more fully in an earlier paper[2].

The environment can be described in different ways according to the inquirer's point of view. H. A. Murray sees it as a source of stimuli (data input) to which the individual responds (data output). Roger Barker on the other hand sees a continuum between the two. That is, the individual constructs a "setting" in which he is embedded and there is a continuous interaction between the two which continuously modifies this construct, and through which the data flows. Rudolf Moos has analyzed the environment into types such as ecological, organizational structures, function and behavior. For example, the individual's problem may be to manage the library's technical services. He then sees certain parts of the input data in terms of the administration structure of that department and so he constructs an appropriate organizational environment. I refer you to the paper on human environments in the forthcoming 3rd NATO Advanced Study Institute on Information Science for a detailed analysis of these and other environmental types.[3]

In essence we learn from psychology and systems theory that the individual creates his own data flow system according to his own intentions, goals, problems and situation at the moment. The flow and modification of data by the individual is dynamic in the sense of these changing structures and parameters.

This would suggest that the library is not books and bibliographic tools, but rather human systems constructed by each user that continually change according to each user's needs. This also holds for librarians and other staff members who make their own constructs according to their own intentions, goals, problems and situations. This suggests that we who train librarians must emphasize not static organizations and operational standards in a library, but rather various constructs that we can expect from both staff and users. Library administrators must also build flexibility into their library operations to accommodate these variations. Regrettably I see little sensitivity on either point. We teach what is standard practice in most libraries to satisfy the needs of an average user. But let us go on and delve a little deeper into some of the specific factors that influence data flow and modifications.

Data Modification Factors

Information science has restricted its construct of the individual almost exclusively to that of a "black box" mentioned earlier. That is to say, they identify and measure outputs from given inputs with little concern for the actual interval processes involved. This was the position common to all five presentations made at the 1977 AAAS symposium on Information Science.[4]

Yet thinking is not so narrow as this statement would suggest. Psychology with its emphasis on the description on structure of the inner man has provided us with useful insights into factors that influence this internal data processing in the individual. The actual number of psychologists working in areas directly or indirectly related to the

processing of data and their effects on the individual is so large that identification of researchers is out of the question, however, a special note should be made of the work by S. S. and S. C. Struefert in the early 1970's at Purdue University. They were especially interested in the effects that data complexity and data load had on the individual.[5] I mention them for two reasons. They are among the few psychologists who emphasize data flow, and it was they who first brought together most of the factors discussed below.[6]

Following the man-environment model proposed earlier, let us organize data influencing factors into three groups--internal, environmental, and interface. These are factors that enhance, abet, modify, evaluate data in the individual as he needs to make decisions and solve problems.

First among the internal factors is personality. This is the name given to all these basic stable characteristics of the individual. One need only mention a few personality types such as internal/external control, curiosity, idealism, rigidity and impulsiveness to sense their importance in the processing of data. For example an internal oriented person is one who is likely to approach the reference librarian and say, "Where can I find information on Denmark;" whereas the externally oriented person would say "What is the capital of Denmark?" Obviously the whole procedure of seeking, processing and evaluating data is different for each.

Next, and closely related to personality, are those cultural antecedents that each of us have developed as stable reflections of the communities from which we came. The way in which one accepts, modifies and evaluates data received is a function of his family, region and

national norms. For example, the Turk has been taught from childhood to accept without question data received from a recognized authority. This acceptance of the data's validity will be determined by his acceptance of the authority of the source.

The other two internal factors are temperal in nature. The individual selects a set of initial conditions and a point of view in response to the problem at hand. For example, the individual may decide to reject some specific data (evidence) presented to him and rely on an authority for no apparent reason than his personal decision to do so.

External factors are four in kind. The simplist is the physical/temporal conditions existing at the moment. Obviously, if the individual is not present at the time data is transferred, he cannot receive it. Within this boundary, the situation is more involved. The individual is influenced by his judgement as to the data's complexity and quantity. If the data appears too simple or there is little transmitted, the individual becomes bored and doesn't respond. If, on the other hand, it is too complicated for him to follow or the load is high, he becomes confused and the results are the same. Studies show that each individual in each situation has an optimum data reception setting.

The last external factor is the task demand placed on the individual. If this address were being given to my students rather than you, the pressure on them would be such as to encourage concentration and attention as they receive and process my words. You on the other hand can relax and be blasé because you will not be graded.

Finally there are two interface factors that deserve recognition. The first is the physiology of the individual. If data exists in the

external world and the mind processes it, where do we place the human body? Are human senses internal or external? We might accept Descate's paradigm of a dual mind and body, but this would sometimes lead to gross distortions. I prefer to leave this question to the inquirer, and give him the freedom to construct a model to fit his purposes. Thus the senses are interface elements in data flow paradigm, and we measure the effects differently according to our design choice.

The congruency element cannot be dismissed so easily. We know from learning theory, cognition theory and the like that the individual develops a familiarity with his environment through practice. To put this in information science terms we can say that he develops an internal construct that enhances or makes more efficient the flow and modification of data. For example, the reference librarian constructs an internal data processing structure that allows for a very efficient interaction with the card catalog. The technical processing librarian on the other hand develops a different construct to satisfy unique needs, and finally the new library user has little if any congruency with the catalog.

As administrators of libraries you may very well say at this point, "This is all fine as abstract theory, but how do I apply these ideas? What are the appropriate measures and design criteria?" I am afraid I have little to offer you today in terms of concrete answers to these questions. Psychology has been interested primarily in identifying these factors and constructs. Information science hasn't begun to establish appropriate algorithms and measurement standards. However this is no reason to reject this paradigm of the library and data flow. It still provides us with much more depth and breadth of understanding

of library operations; and it can give much more flexibility and latitude in problem solving and decision making to administrators.

User's interactions with the library must also be recognized. They too are continuously involved in the transmission, reception and processing of data using the same paradigms suggested here. I suggest that you can increase your understanding of and empathy toward your patrons by recognizing the similarity between their data systems and yours.

Finally, you can help those of us who are concerned with the design of systems and the education of future librarians. The state-of-the art in this area today is such that we need a lot of field experience and data. I am not at all sure that controlled laboratory experiments can give us dependable design data that is applicable to your conditions in the field. Your libraries are our laboratory.

Conclusion

By way of a summary and conclusion let me restate succinctly what I am proposing to you as administrators of libraries. I am suggesting that you throw off the traditional paradigm of the library as a service with a fixed structure, and think of it as one of the dynamic functions of each individual whose structure is determined by that individual. Your primary role is to have a repetoire of library constructs that will optimize the interaction and congruence between the individual user and the data you control. I have suggested some of the human factors intrinsic to these construct designs.

Finally I remind you that I have stated only half the problem. This user is like the two faces of a coin. He is also a part of a social group; and your role is also to optimize the interaction between the library and the social groups who are users. In essence we recognize these two groups as we design small special libraries differently from large ones. The library serving a small clientel can give individual attention. The large one cannot.

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